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(54) (Title of the Invention)

Optical Disk Label Surface Image Formation Method and Optical Disk Apparatus And Optical Disk

(57) (Summary)

(Task)

To perform image formation on the surface of a label for optical disks by using laser rays of an optical disk apparatus.

(Means To Solve Problems)

A layer having visible variable optical characteristics is formed in a location visible from the label surface side of an optical disk by using photosensitive material, heat sensitive material, or the like. This optical disk is set so as to face the lower surface of the label on a turntable of an optical disk apparatus and relative movement of the optical disk and an optical pickup is initiated along to the surface of the optical disc. Said movement is synchronized, and a wafer for laser light emitted from the optical disk pickup is irradiated so as to form images, letters, pictures and similar image data which is modulated by irradiation applied to a modified layer having visible variable optical characteristics. The visible optical characteristics are of the visible variable optical characteristics layer are changed when it is irradiated with this laser light so that an image is formed on the surface of a label.

[Figure]

22: label surface
10: optical disk (CD-R)
20: protective layer
18: visible variable optical characteristics layer
16: reflection layer
14: coloring matter layer (recording layer)
12: substrate
↑ incident light surface for data recording with laser rays

(Scope of the Patent's Claims)

(Claim 1)

An optical disk label surface formation method for forming an image on a corresponding label surface,

wherein a visible variable optical characteristics layer is formed, the visible optical characteristics thereof are changed from the side of the label surface by applying irradiation with laser rays from the label side in a location visible from the label surface side of the optical disk;

said optical disk is set on a turntable of an optical disk apparatus so as to face the side of incident laser light emitted from an optical pickup and applied to this label surface, relative movement is induced with respect to said optical disk and said laser rays along the surface of the optical disk;

and the laser rays, which are modulated in response to image data such as letters, pictures or the like so as to form images in synchronization with this relative movement, irradiate said visible variable optical characteristics layer from the side of sad label surface;

wherein changes of visible optical characteristics of the visible variable optical characteristics layer are induced by the irradiation.

(Claim 2)

The optical disk label surface image formation method described in claim 1, wherein said laser rays are provided with a power above a specified power.

(Claim 3)

The optical disk label surface image formation method described in claim 1, wherein while said optical disk is rotated, said optical pickup is moved in the radial direction of the optical disk.

(Claim 4)

The optical disk label surface image formation method described in claim 1, wherein a standstill of said optical disk is initiated, and said optical pickup is moved in the radial direction and in the track linear direction orthogonal to the radial direction of the optical pickup.

(Claim 5)

An optical disk apparatus controlling image formation on a layer having visible variable optical characteristics,

equipped with a relative movement mechanism initiating relative movement along an optical disk of laser rays emitted from an optical pickup, and of an optical disk set on a turntable so that the label surface is facing the side of incident rays of the laser light;

with a laser modulation circuit which modulates the laser light emitted from said pickup;

and with a control circuit controlling said relative movement mechanism and said laser modulation circuit;

wherein said control circuit controls relative movement of said laser rays and said laser disk, controlled by said relative movement control mechanism,

said laser modulation circuit is controlled so as to form images such as letters, pictures or the like corresponding to image data on the label surface of the optical disk and to the relative movement;

the image data is modulated with the laser rays emitted from said optical pickup;

and the visible optical characteristics are changed by irradiation with said laser rays so that corresponding images are formed which are visible from the side of the label surface of the optical disk.

(Claim 6)

The optical disk apparatus described in claim 5,

equipped with a rotational movement apparatus which rotates and moves a turntable with said relative movement mechanism;

and with a driving apparatus for feed in the radial direction, moving said optical pickup in the radial direction of said optical disk;

wherein said control circuit controls the relative movement of said laser rays and of said optical disk, which are controlled by both of these apparatuses.

(Claim 7)

The optical disk apparatus described in claim 6, wherein said control circuit drives said rotation driving apparatus with a constant number of rotations, so that a specified driving amount is applied to each specified rotational position with said driving apparatus for feed in the radial direction.

(Claim 8)

The optical disk apparatus described in claim 6, equipped with a peripheral position detection apparatus detecting the position in the peripheral direction of said optical disk;

and with a radial direction position detecting apparatus detecting the position in the radial direction of the optical disk of said optical pickup;

controlling the detection position of both of these position detection apparatuses, and the laser rays emitted from said optical pickup, which are controlled by said control circuit so that they are modulated in response to image data such as letters, picture or the like so as to form images on the label surface of said optical disk.

(Claim 9)

The optical disk apparatus described in claim 8, equipped with a frequency generator generating a frequency signal corresponding to rotations when said peripheral direction position detection apparatus is rotated by said rotation driving apparatus;

and with a multiplier which multiplies the frequency of the signal generated by the frequency generator.

(Claim 10)

The optical disk apparatus described in claim 5, equipped with a driving apparatus for feed in the radial direction, wherein said relative movement apparatus causes movement of said optical pickup in the radial direction of said optical disk;

and with a driving apparatus for feed in the track linear direction, causing movement in the track linear direction of said optical disk orthogonally to the movement in the radial diction of the optical pickup;

wherein said control circuit controls the relative movement of said laser rays and of said optical disk, controlling both driving apparatuses during a standstill status of said turntable.

(Claim 11)

The optical disk apparatus described in claim 10, equipped with a radial direction position detection apparatus which detects the position of said optical pickup in the radial direction of the optical disk;

and with a track linear direction position detection apparatus which detects the track linear direction position of the optical disk orthogonally to the movement direction in the radial direction of the optical disk of the optical pickup;

wherein said control circuit controls laser rays emitted from said optical pickup, and the detection position of both of these detection apparatuses, so that modulation control is performed corresponding to image data such as letter, pictures or the like in order to form an image on the label surface of said optical disk.

(Claim 12)

The optical disk apparatus described in any of the claims 5 ~ 11, wherein said control circuit sets the tracking servo OFF, the focus servo is set ON or OFF, and relative movement of said laser rays and said optical disk is performed.

(Claim 13)

The optical disk apparatus described in any of the claims 5 ~ 12, wherein while the relative movement of said optical disk and said laser rays is in progress, said control circuit controls the oscillation operations applied to the tracking actuator of said optical pickup.

(Claim 14)

An optical disk, wherein a visible variable optical characteristics layer is formed, and the visible optical characteristics are changed by irradiation applied from the label surface side with laser rays from the label surface side to locations visible from the label side.

(Claim 15)

The optical disk described in claim 14, wherein said visible variable optical characteristics layer is a layer enabling color changes relating to at least any of changes such as hue, brightness, or saturation, induced by irradiation with said laser rays.

(Claim 16)

The optical disk described in claim 14, wherein said color changing layer is a photosensitive layer or a heat sensitive layer.

(Claim 17)

The optical disk described in claim 16, wherein said photosensitive layer or heat sensitive layer has 2 layers, and the visible optical characteristics thereof are changed by fusing or mixing these 2 layers through irradiation with laser rays.

[page 3]

(Claim 18)

The optical disk described in any of the claims 14 through 17, wherein said optical disk is formed with a sequential structure of films on the substrate of said optical disk, comprising at least a recording layer, a reflection layer and a protective layer, and wherein said visible variable optical characteristics layer is formed between a reflection layer and a protective layer.

(Claim 19)

The optical disk described in claim 18, wherein an intermediate layer is arranged between said reflection layer and said visible variable optical characteristics layer.

(Claim 20)

The optical disk described in claim 19, wherein said intermediate layer is constructed from a material increasing the adhesiveness between said reflection layer and said visible variable optical characteristics layer.

(Claim 21)

The optical disk described in claim 19 or 29, wherein said intermediate layer is constructed from a material increasing the heat insulation characteristics of said reflection layer and said visible variable optical characteristics layer.

(Claim 22)

The optical disk described in an of the claims from claim 19 to 21, wherein said intermediate layer is constructed with a light scattering layer having semitransparent light scattering characteristics.

(Claim 23)

The optical disk described in claim 18, wherein a part containing said visible variable optical characteristics layer is deployed between said reflection layer and said protective layer;

so that it is finely mixed with a part in which the protective layer is directly connected with the reflection layer, which does not contain the visible variable optical characteristics layer.

(Claim 24)

The optical disk described in claim 23, wherein a plurality of point shapes or a plurality of empty hole shapes is formed in said visible variable optical characteristics layer between the reflection layer and the protective layer;

wherein the reflection layer is connected directly with the protective layer on the outer

side of the points or on the inner side of the holes.

(Claim 25)

The optical disk described in claim 18 or 19, wherein a second reflection layer is arranged between said visible variable optical characteristics layer and said reflection layer, and a separation layer separating both reflection layers is arranged between said reflection layer and said second reflection layer.

(Claim 26)

The optical disk described in any of the claims from claim 14 to claim 17, wherein said optical disk has a laminated arrangement comprising between 2 substrates, comprising at least a recording layer and a reflection layer;

wherein said reflection layer creates a laminated structure on the surface side of the substrate on the side facing the reflection film, comprising at least a second reflection layer, and said visible variable optical characteristics layer.

(Claim 27)

The optical disk described in claim 26, wherein an intermediate layer is arranged between said second reflection layer and said visible variable optical characteristics layer.

(Claim 28)

The optical disk described in claim 27, wherein said intermediate layer is constructed from a material increasing adhesiveness between said reflection layer and said visible variable optical characteristics layer.

(Claim 29)

The optical disk described in claim 27 or 28, wherein said intermediate layer is constructed from a material increasing heat insulation between said reflection layer and said visible variable optical characteristics layer.

(Claim 30)

The optical disk described in any of the claims from claim 27 to 29, wherein said intermediate layer is constructed with a light dispersion layer having semitransparent light dispersion characteristics.

(Detailed Explanation of the Invention)

(0001)

(Sphere of Technology Belonging to the Invention)

This invention relates to an optical disc and an optical disk apparatus and to a method for formation of an image on the label surface of an optical disk, using laser rays of an optical disk apparatus to achieve image formation on a label surface.

(0002)

(Prior Art Technology)

In order to enable visual confirmation that recording has been performed an optical disk in optical disks of the recordable type, information relating to the content of the recording (title or the like) is added by being written on the optical disk by a user. In this case, when one-sided optical disks were used not accommodating the CD-R (CD recordable), CD-RW (CD rewriteable) cartridges or the like, the writing was generally performed with a pen used to write directly on the label surface of an optical disk. Also, according to another method, information relating to the content was edited with a PC, then printed with a printer and pasted onto the label surface.

(0003)

(Task To Be Achieved By This Invention)

Because a hard pen or a similar instrument was used to apply strong pressure with the method when writing was applied directly to the label surface of a disk, this would sometime damage the recording layer. Moreover, a separate printer had to be used with the method using printing of labels. In view of the above mentioned disadvantages, this invention provides an optical disc and an optical disk apparatus, as well as a method for image formation on the label surface of an optical disk which does not require printing with a printer or writing with a pen to make it possible to create an image on the surface label by using laser rays of an optical disk apparatus.

(0004)

(Means To Solve Problems)

According to the method of this invention for image formation on the label surface, a layer is formed with visible variable optical characteristics, and the visible optical characteristics (color, hue, brightness, saturation, spectrum, reflectivity, transmittance, light scattering, etc.) are changed through irradiation with laser rays from the label surface side in a location visible from the side of the label surface of an optical disk. Said optical disk is set on a turntable of an optical

disk apparatus, and laser rays are emitted from said optical pickup of said optical disk, set so as to face the side of incident laser light, relative movement of said laser rays is initiated along the surface of the disk, and laser rays emitted from said optical pickup are synchronized with this relative movement so as to form images such as letters, pictures or similar image data, which is modulated accordingly when said layer having visible variable optical characteristics is irradiated from the side of said surface label, the visible optical characteristics of the layer having visible variable optical characteristics are thus changed by this irradiation, so that a corresponding image is formed on the label surface. According to this method for image formation on a label surface, a layer provided with visible variable optical characteristics is irradiated with the laser light of a laser disk apparatus to initiate image formation in locations visible from the label surface side of the laser disk, and because the visible optical characteristics of this layer are changed, letters, pictures or similar images can thus be formed on the label surface so that it is no longer necessary to write a label with a pen or use a printer for printing.

[page 4]

(0005)

The method of this invention for image formation on a label surface can be used for example with laser rays above a specified power. In addition, while said optical disk is being rotated, said optical pickup is moved in the radial direction of the optical disk. Further, when a standstill of said optical disk is caused, said optical pickup can be moved in the linear direction orthogonal to the radial direction of the optical disk and the radial direction of the optical disk.

(0006)

The optical disk apparatus of the present invention is equipped with a relative movement apparatus causing relative movement along the surface of the optical disk of laser rays emitted from an optical pickup, and of a laser disk set so as to face the side of incident laser rays applied to a laser label on a turntable; with a laser modulation circuit which modulates laser rays emitted from said optical pickup; and with a control circuit of said laser modulation circuit and said relative movement mechanism.

Said control circuit controls said relative movement mechanism, causing relative movement of said optical disk and said laser light. Said laser modulation circuit changes image data with laser rays emitted from said optical pickup, controlled according to image data such as letters, pictures, or the like, so that image data can thus be formed on the label surface of the optical disk during its relative movement, and a corresponding image is formed in locations visible from the side of the label surface of the optical disk. Image formation can thus be controlled on a variable layer having visible optical characteristics when the visible optical characteristics are changed with the irradiation of said laser light, and the label surface image formation method of this invention can thus be realized.

(0007)

The optical disk apparatus of this invention is equipped for example with a rotation driving mechanism which drives and rotates a turntable of a relative movement mechanism, and with a driving apparatus providing in the radial direction movements of said pickup in the radial direction of said optical disk. Said control circuit, which controls both driving apparatuses, serves to control the relative movement of said laser rays and of said laser disk. In this case, said control circuit can operate said rotation driving circuit with a constant number of rotations, and said apparatus supplying driving in said radial direction can supply a specified driving amount for each specified rotational position. The configuration can further be also equipped with a circumferential direction position detection apparatus which detects the circumferential direction position of said optical disk, and with a radial direction position detection apparatus which detects the radial direction position of said optical disk. Said control circuit can be used to control the laser rays emitted from said optical pickup, the detection position of both position detection apparatuses, and to regulate it in accordance with image data such as letters, pictures or the like so as to form an image on the label surface. Also, the position information of said image data can be displayed with coordinate data by combining the circumferential direction position of the optical disk with the radial direction position of the optical disk. Further, said circumferential direction detection apparatus can be rotated with said rotation driving apparatus, provided with a frequency generator generating frequency signal in response to these rotations, and with a multiplier which multiplies the frequency of the signal generated by the frequency generator.

Said relative movement mechanism can be also equipped with a driving mechanism providing feed in the radial direction and causing movement of said recording pickup in the radial direction of said recording disk, in a driving mechanism providing feed in the track linear direction to cause movement of the pickup in the track linear direction of said optical disk, orthogonal to the movement direction of the radial direction. Said control circuit controls both driving apparatuses during the standstill status of said turntable, making it possible to control the relative movement of said laser light and of said optical disk. The configuration can be also equipped with a radial direction position detection mechanism which detects the radial direction position of the optical drive of said optical pickup, and with a track linear direction position detection apparatus which detects the track linear direction position of the optical disk, orthogonal to the movement direction of the radial direction of the optical disk of the optical pickup. Said control circuit can be used to control the laser rays emitted from said optical disk pickup, controlling the detection position of both position detection apparatuses, so that a corresponding regulation can be applied to image data such as letters, or pictures or the like, so as to form an image on the label surface of said optical disk. Also, the position information of said image data can be displayed as coordinate data combining optical disk track linear direction position, orthogonal to the movement direction of the optical disk, of said optical pickup, with the radial direction position of the optical disk. Further, said control circuit can be used to realize relative movement of said laser rays and of said laser disk so that tracking servo is turned OFF, and a focus servo is turned ON or OFF. Furthermore, the optical disk apparatus of the present invention can be created as an optical disk recording device combining 2 laminated substrates on an optical disk of the DVD type, such as DVD-R (DVD recordable), or a DVD-RW (DVD rewriteable) optical disk.

(0008)

The optical disk of this invention forms an integrated variable layer having visible optical characteristics, so that the visible optical characteristics can be modified from the label surface side through irradiation with laser rays obtained from the label surface side. The laser label surface image formation method can thus be realized with this optical disk. Also, because the layer having variable visible optical characteristics is formed integrated with the optical disk, this makes it possible to prevent oscillations occurring during high-speed rotations due to eccentricity, when compared to the label pasting method, and occurrences of breakdowns which can be caused by peeling of the labels inside the drive can be also prevented.

(0009)

The optical disk of the present invention can contain said layer having visible variable optical characteristic, enabling to create layers in different colors by changing at least any one of its characteristics, such as the hue, brightness, through irradiation with said laser light. The color changes of said layer can be also achieved with a photosensitive or heat sensitive layer.

[page 5]

Moreover, when a structure comprising 2 layers is employed for the color changing design layer (photosensitive layer and heat sensitive layer), irradiation with laser rays can be used to cause fusion mixing due the visible optical characteristics in these 2 layers.

Furthermore, said optical disk can be provided on the substrate with a sequential film construction comprising at least a recording layer, a reflection layer, and a protective layer, and said variable layer having visible optical characteristics can be formed between the reflection layer and the protective layer. An intermediate layer can be also placed between said variable layer having visible optical characteristics and said reflection layer. This intermediate layer can be provided for instance with adhesive characteristics to said layer having visible variable optical characteristics and to said reflection layer, and formed from a material increasing heat insulation characteristics, etc. The intermediate layer can be also formed from a semitransparent material with a construction creating a light scattering layer, to make it easier to see the formed image. Between said reflection layer and said protective layer can be placed a part of said variable layer having visible optical characteristics, and of the reflection layer without the variable layer having visible optical characteristics, which can be connected directly with the protective layer, creating the formation of a finely mixed part. Because the structure has a part in which the reflection layer is directly connected with the protective layer, this provides for superior adhesiveness. The variable layer having visible optical characteristics can be also opaque, passing through the part not containing the layer having visible variable optical characteristics, in which the reflection layer is directly connected with the protective layer. Since the reflection layer can be seen partially from the side of the label surface, this enables to adjust easily the focus to the reflection layer when an image is formed on the label surface. Also, a construction creating fine mixing

between the part where the variable layer having visible optical characteristics is present, and a part connected directly to the protective layer and reflection layer in which the variable layer having visible optical characteristics is not present, can be formed for instance with a plurality of point shapes or a plurality of hole shapes between the reflection layer and the protective layer of the variable layer having visible optical characteristics, making it possible to realize a direct linking design between the reflection layer and the protective layer on the inner side of the holes or on the outer side of the spots. In addition to the spot shape and to the hole shape, a construction with a concentric circuit shape, or a linear stripe shape or the like can be also employed. The optical disk of the present invention can be formed by arranging a second reflection layer between said variable layer having visible optical characteristics and said reflection layer, or by arranging in the design a separation layer separating these reflection layers. This will then enable to prevent with reliability influence from being exerted by heat on the recording layer when the label surface is hot during film formation, and to prevent influence from being exerted on the variable layer having visible optical characteristics during recording of data. The optical disk of the present invention can be provided with a laminated arrangement at least of the recording layer and reflection layer between 2 substrates of said optical disk, wherein on the surface side of the substrate on the side facing the reflection film, at least 2 reflection layers can be placed, creating a laminated layer arrangement of the variable layer having visible optical characteristics. In this case, an intermediate layer can be also deployed between said second reflection layer and said variable layer having visible optical characteristics. The intermediate layer can be constructed for instance from a material increasing the adhesiveness and heat insulation characteristics, etc., of said variable layer having visible optical characteristics and of said reflection layer. The optical disk of this invention can be for example a CD-R, DC-RW or a similar type of optical disk, or a DVD-R, DVD-RW or similar type of DVD optical disk, etc., with 2 combined substrates attached to the optical disk, for example with the reflection type of a recordable single-side optical disk, or an optical disk corresponding to other specifications can be also used.

(0010)

(Embodiment of the Invention)

The following is an explanation of an embodiment of this invention. Figure 1 shows a partial profile view of a realized embodiment of the optical disk of this invention (the thickness of each of the layers is in reality different and guide grooves are also omitted in the illustration). This figure thus illustrates an example of a CD-R disk compatible with this invention. The film structure of this optical disk 10 is formed sequentially from a coloring matter layer (recording layer) 14 on one face of a transparent substrate 12, which can be made from polycarbonate or the like, a reflection layer 16, a visible variable optical characteristics layer 18, and a protective layer 20, so that the entire structure creates an integrated construction. Except for the fact that the visible variable optical characteristics layer 18 is provided, the structure is identical to that of a common CD-R disk. The visible variable optical characteristics layer 18 can be viewed through the transparent protective layer 20 from the side of the label surface 22. Because when the visible variable optical characteristics layer 18 is irradiated with laser rays above a specified power from

the side of the laver surface 22, color changes of the visible optical characteristics are caused in the irradiated locations (hue, brightness, saturation), as well as changes of the spectrum (reflectivity, transmittance, light scattering, and the like), this makes it possible to create a change in the layer structure, for example when the color of a photosensitive or a heat sensitive material is changed (for instance from white to colorless, or black, etc.), or from transparent to a certain color (such as black, etc.). If a photosensitive layer structure is used for the visible variable optical characteristics layer 18, for instance with incident light rays applied from the label surface 22 with a laser light using the wavelength of 780 nm, photosensitivity will not be created with a laser light power below 1 mW. However, photosensitivity will be created and color changes will be caused above 1 mW when a photosensitive material is used. Also, if the visible variable optical characteristics layer 18 is made of a heat sensitive material, for example one can use a photosensitive material that will not induce photosensitivity below 100 degrees Celsius, but that will change color above 100 degrees Celsius. Also, since incoming laser rays creating incipient light from the side of the surface 22 when data is recorded or played back on the optical disk 10 will be mostly blocked by the reflection layer 16, changes of visible optical characteristics will not be generated in the variable visible layer 18 having optical characteristics. Also, as shown in Figure 2, the construction of the variable visible layer 18 having optical characteristics is made up of 2 layers, layer 18-1, and layer 18-2, and structure of these two layer 18-1, 18-2 can create changes of visible optical characteristics when the layers are fused or mixed due to irradiation with laser rays.

(0011)

As shown in Figure 3, an intermediate layer 24 can be deployed between the reflection layer 16 and the layer 18 having visible variable optical characteristics. The intermediate layer 24 can be constructed for instance from a material that increases adhesiveness, insulation characteristics and the like between the reflection layer 16 and the visible variable optical characteristics layer 18. Any material having good adhesiveness both to the reflection layer 16 and to visible variable optical characteristics layer 18 can be used in the intermediate layer 24 in order to increase adhesiveness. Since the structure of the insulating material contained in the intermediate layer 24 suppresses conduction of heat to mutually opposite sides when heat is generated during image formation on the label surface, this makes it possible to suppress the influence exerted by heat to the visible variable optical characteristics layer 18 when data is recorded, and the influence exerted by heat generated when an image is formed to the label surface.

[page 6]

In addition, when the reflection layer 16 is directly connected to the visible variable optical characteristics layer 18, the heat generated during image formation on the label surface passes through the reflection layer 16 (which will be often made from metal), which can decrease the effect of the changes in visible optical characteristics of the visible variable optical characteristics layer 18, and although there is a concern that this could cause blurring of the formed images, as long as the intermediate layer 24 is made from heat insulating material,

spreading of the heat generated during image formation on the label surface, which passes through the reflection layer 16, will be restrained to the surface direction, making it possible to prevent a decreased effect of the changes in visible variable optical characteristics and blurring of images. When the construction of the intermediate layer 24 comprises a light scattering layer having semitransparent light scattering characteristics, the formed images can bee seen easily. As a method increasing the adhesiveness between the reflection layer 16 and the visible variable optical characteristics layer 18, instead of deploying an intermediate layer, it is possible to form in this case a plurality of fine point shapes as indicated in Figure 4, (for instance with circular shape and with a diameter in one point of about 10 μm or a with a non-circular shape in the same size), in the visible variable optical characteristics layer 18, (for example by using the film transfer technique or a similar technique). Moreover, instead of a plurality of such point shapes, it is possible to form a plurality of fine holes 26 as shown in Figure 5 with the empty hole shape. Because when the shape indicated in Figure 4 is formed, the reflection layer 16 will be linked directly with the protection layer 20 on the outer side of the points, or if the point shape shown in Figure 5 is formed, on the inner side of the empty holes, this makes it possible to achieve optimal adhesiveness. In addition, even if the visible variable optical characteristics layer 18 is opaque, a partial view of the reflection layer 16 is enabled from the side of the label surface 22 through the part in which the reflection layer 16 is directly connected with the protective layer 20 which does not have the visible variable optical characteristics layer 18, enabling to adjust focusing easily on the reflection layer 16 during image formation on the label surface 22. It is also possible to employ another construction in addition to the point shape or the empty hole shape, such as concentric circles or linear stripes or the like.

(0012)

Figure 6 shows a partial profile view of another embodiment of the optical disk of this invention (the thickness of each layer is different from the real thickness and guide grooves are also omitted from in this drawing). This shown example of this invention is compatible with a CD-RW disk. Optical disk 28 of this example is provided with a sequential construction of films comprising a dielectric layer 32 on one side of a transparent substrate 30, which can be made of polycarbonate or similar material, as well as a recording layer 34, a dielectric layer 36, a reflection layer 38, a visible variable optical characteristics layer 40, and a protective layer 42, creating an integrated construction of the entire structure. Except for the fact that the visible variable optical characteristics layer 40 is provided, the construction is identical to that of a CD-RW disk. The visible variable optical characteristics layer 40 can bee seen through a transparent protective layer 42 from the side of the label surface 44. The visible variable optical characteristics layer 18 can have the same construction as in the embodiment shown in Figure 1. In addition, an intermediate layer can be deployed to increase adhesiveness between the reflection layer 38 and the protective layer 42 in the same manner as in Figure 3. Further, if the visible variable optical characteristics layer 40 is formed with the plurality of fine points having the shape shown in Figure 4, or with a plurality of fine holes having the empty hole shape as shown in Figure 5, this makes it possible to form a concentric circle or a linear stripe shape or the like. Figure 7 shows a partial profile view of another embodiment of the optical disk of this invention (the thickness of each layer is different from the real thickness and guide grooves are

also omitted from in this drawing). This shown example has a separation layer 35, a second reflection layer 37, and an intermediate layer 39, creating a laminated arrangement between the reflection layer 38 and the visible variable optical characteristics layer 40 in the CD-RW disk 28 shown in Figure 6.

The second reflection layer 37 can be constructed of a metallic layer, a dielectric reflection layer, etc. When this is the case, because the reflection layers 37, 38 are deployed independently for image formation and for recording of data on the label surface, the separation layer 35, which can be formed from a resin, etc., and is inserted between both reflection layers 37, 38, creates a buffer layer with respect to transfer of heat. This makes it possible to prevent reliably that an influence will be exerted by heat on the recording layer during image formation on the label surface, and that influence will be exerted on the visible variable optical characteristics layer by heat during recording of data. The intermediate layer 39 can be constructed for example form a material increasing the adhesiveness between the reflection layer 37 and the visible variable optical characteristics layer 40 (a material that has good adhesiveness both to the reflection layer 37 and to the visible variable optical characteristics layer 40). Further, if the intermediate layer 39 is constructed from a heat insulating material, spreading of the heat generated during image formation on the label surface, which passes through the reflection layer 37 in the surface direction, is suppressed, enabling to prevent a decreased effect of the changes in visible variable optical characteristics and blurring of the image. Further, when the construction of the intermediate layer 39 comprises a light scattering layer having semitransparent light scattering characteristics, the formed images can bee seen easily. Figure 8 shows yet another embodiment of the optical disk of this invention (the thickness of each layer is different from the real thickness and guide grooves are also omitted from in this drawing). This embodiment of this invention is compatible with a DVD-RW disk having 1 recording layer on a single surface.

This optical disk 41 has a sequential formation of films on one surface of a transparent first substrate 43, which is 0.6 mm thick and which can be made from polycarbonate or the like, comprising a dielectric layer 45, a recording layer 47, a dielectric layer 49, and a reflection layer 51. Further, a second substrate 55 (normally a transparent substrate) with a thickness of 0.6 mm, made from polycarbonate, etc., is glued with an adhesive layer 53 on top of the reflection layer 51. On the surface of the second substrate 55 is sequentially formed a laminated layer comprising a second reflection layer 57, an intermediate layer 59, a visible variable optical characteristics layer 61, and a protective layer 63. A label surface 65 is created on the side surface of the protective layer 63. Recording of data is performed by irradiating the recording layer 47 with laser rays from the surface side of the first substrate 43. An image is formed on the label surface 65 by applying irradiation with laser rays from form the side of the label surface 65 to the visible variable optical characteristics layer 61. The second reflection layer 57 can be constructed from a metallic layer, or from a dielectric reflective material or the like. The intermediate layer 59 can be made for instance from a material that increases the adhesiveness between the second reflection layer 57 and the visible variable optical characteristics layer 61, (a material that has good adhesiveness both t0 the reflection layer 57 and to the visible variable optical characteristics layer 61). Also, when the intermediate layer 59 is made form a heat insulating material, spreading of the heat generating during image formation on the labels surface, which passes through the

reflection layer 57, can be restrained in the surface direction. This makes it possible to prevent a decreased effect of the changes in the visible variable optical characteristics and blurring of the image. Furthermore, if the intermediate layer 59 is made from a material having semitransparent light scattering characteristics, the formed images can bee seen easily.

(0013)

Figure 9 shows an embodiment of the optical disk apparatus of this invention (only the part related to image formation on the label surface).

[page 7]

In this case, the construction uses a CD-R-RW drive connected to a host computer, for instance a PC (an optical disk recording apparatus enabling recording and playback of data on a CD-R disk and CD-RW disk). In a CD-R/RW disk 48, which is mounted on a turntable 54, a spindle motor 56 drives in reverse direction to the back surface (below the label surface 52) optical disk 50 of this invention (the CD-RW disk 28 shown in Figure 6, or the CD-R disk 10 shown in Figure 1 ~ Figure 10, etc.). A frequency generator 58 (FG) is connected directly to the rotational axis of the spindle motor 56, so that a pulse signal (FG pulse) is generated for each degree of the rotation according to specified integral divisions for 1 rotation of the spindle motor 56 received from the frequency generator 58. The FG pulse is input to a system control circuit (CPU) 62 multiplied by a specified multiple with a multiplier 60 in a configuration including a PLL circuit, etc. When an image is formed on the label surface, the spindle servo circuit 64 exercises control so that constant rotations are performed with a number of rotations indicated by instructions received from the system control circuit 62 to the spindle motor 56 based on the FG pulse.

(0014)

Under the optical disk 50 is arranged an optical pickup 66 carrying out recording of data, playback of data, and applying image formation to the label surface. The optical pickup 66 is supported by feed screw 68, enabling free movement in the radial direction of the optical disk 50. Depending on the instruction from the system control circuit 62, a feed motor 72 is driven via a motor drive 70, the feed screw 68 is rotated, and the optical disk 66 can thus be moved in the radial direction of the optical disk 50. The position in the radial direction of the optical disk of the optical pickup 66 is detected by a feed position detector 74, provided with a linear screw or the like. A focus servo circuit 76 performs focusing control and drives the focus actuator of the optical pickup 60 based on the focus error signal. When image formation is performed on the label surface, the focus servo circuit 76 is ON. During recording and playback of data, a tracking servo circuit 78 controls tracking and drives the tracking actuator of the optical pickup 66 based on the tracking error signal. When an image is formed on the label surface, a specified oscillation signal is generated based on the instructions from the system control circuit 62 and supplied to the tracking actuator. Because of that, an objective lens of the optical pickup 66 makes it possible to obtain an image that is free of gaps, with embedded scan intervals for laser rays determined for

each circumference during oscillations in the radial direction of the optical disk 50.

(0015)

When the laser driver 82 drives a laser diode of the optical pickup 66 based on the instructions obtained from the system control circuit, the optical disk 50 is irradiated, enabling to perform data recording, data playback, and formation of images on the label surface.

Specifically, because the laser diode emits laser rays with the recording power modulated with the recording signal during recording of data, laser rays are emitted with a constant playback power during playback of data, and laser rays are modulated with image data such as letters, pictures, etc., in order to form images during image formation on the label surface (a high power is created generating changes of the visible optical characteristics in the visible variable optical characteristics layer in the part in which image formation occurs, while a low power of the laser rays is created so that changes will not be initiated in the visible optical characteristics of the visible variable optical characteristics layer in the part in which image formation is not performed). When image formation is performed on the label surface, letters, pictures and similar image data is sent from the host computer 46 to the CD-R/RW driver 48 so as to form images which can be edited by a user. The structure of this image data comprises data displayed by coordinates (r, θ) combining the radial direction position r of the optical disk (the distance from the center of rotations) with circumferential direction position θ (angle in the circumferential direction to a suitable standard position), (for example with a data construction stipulating image formation segments displayed with angle θ for each radial position r of a specified pitch Δr).

(0016)

During the stage when image data is formed on the label surface of the optical disk 50 with the CD-R/RW of Figure 9, for example the following operations are performed.

(1) The optical disk 50 is placed upside down on the turntable 54 when compared to data recording or data playback.

(2) A user edits letters, pictures and other images to create an image on a display of the user computer 46. The host computer 46 converts the edited images to image data.

(3) The user issues an instruction to start image formation operations with the host computer 46.

(4) The pulse generated from the frequency generator 58 is used to control the CAV (constant number of rotations) of the spindle motor 56 with the spindle circuit 64, so as to create a constant frequency as instructed by the system control circuit 62.

(5) The optical pickup 66 determines the reference position in the specified radial direction on the inner peripheral side of the optical disk 50.

(6) A laser driver 82 operates the laser diode by ensuring that the laser power of the laser diode of the optical pickup 66 has a specified low output, as instructed by the system control circuit 62, (with a value enabling focus control without changing the visible optical characteristics of the visible variable optical layer, for instance with a value below 1 mW).

(7) Based on the instructions of the system control circuit 62, the focus servo circuit 76 is set ON. Because of that, the focus servo circuit 76 will apply focus servo operations to achieve the minimal spot with the laser rays 67 in the reflection layer. In addition, the tracking service circuit 78 remains OFF as is, and tracking servo operations are not applied.

(8) Image formation starts according to the instructions from the system control circuit 62, which are adjusted for the image formation preparation as described above.

[page 8]

Specifically, the system control circuit 62 inputs image data from the host computer 64, the feed motor 72 is driven and it is determined that the position of the optical pickup 66 is in the radial position, which the initial position for image formation on the inner peripheral side of the optical pickup 66. A suitable timing based on the FG pulse, (or timing detected by a detector deployed in order to detect the standard position in the peripheral direction), is set as the reference position in the peripheral direction, the output pulse of the multiplier 60 is counted and peripheral position θ is detected, and based on the radial position, the operations are switched to a specified high output of the laser, (for example with a value above 1mW, which is a value changing the visible optical characteristics of the visible variable optical characteristics layer), in each image formation position in the peripheral direction indicated by the image data in the radial position. Because of that, the visible optical characteristics of the visible variable optical characteristics layer are changed in the location irradiated by the laser rays output with a high output (for example to colorless characteristics), and image formation can be performed. Once the optical disk 50 has returned to the standard position in the peripheral direction after 1 rotation, the feed motor 62 is operated and the optical pickup 66 is moved in the peripheral direction outside of the specified pitch Δr, enabling to perform image formation operations by switching the laser power to a specified high output in each image formation position in the peripheral direction indicated by the image data for this radial direction. After that, these operations are repeated and movement is initiated with a specified pitch Δr per each lap sequentially in external peripheral direction so that image formation is performed. Figure 10 shows the trajectory of the laser rays on the label surface 52 of the optical disk 50 during these image formation operations. Figure 11 indicates the changes of the laser power when image formation is conducted as shown in Figure 10.

(0017)

Since scanning is not initiated in radial positions in which image formation will not be located, the operation is moved once up to the radial position containing the next image formation position and image formation is performed. Also, when the pitch Δr is large, as shown in Figure 12, a gap is created for image generation even if an image can be formed continuously with the original radial direction. While the gap can be made inconspicuous if a small pitch Δr is created, this means that the frequency required to form an image on the entire label unit is increased so that a longer time will be required for image formation. Therefore, in the CD-R/RW driver 48 of Figure 9, the tracking actuator is operated with the oscillation signal (sine wave, triangular wave, etc.) generated from the oscillation signal generation circuit 80 during image formation so as to create oscillations in the radial direction of the disk for the objective lens. Because of that, as shown in Figure 13, the laser light is oscillated in the radial direction of the disk and images can be formed without a gap (or with a small gap) even if a relatively large pitch Δr is used. The frequency for the oscillation signal can be for example approximately several kHz. Also, the pitch Δr can be set for instance in the approximate range of 50 ~ 100 μm.

(0018)

Figure 14 (a) shows an example of how image is in reality formed on the label surface 52 with the CD-R/RW driver 48 shown in Figure 9.Figure 14 (b) is a partial enlarged diagram indicating the trajectory of the laser rays when this image is formed. The diagram indicates the situation when the position of radius r1 is scanned in the segments of angle $\theta 1 \sim \theta 2$ with a high output of the laser power.

Figures 15 (a), (b), (c) show other examples of image formation on the label surface 52 with the CD-R/RW driver 48. It is thus possible to form an image from any letter information to create the title of a song, the name of the artist, etc.

(0019)

Figure 16 shows another embodiment of the optical disk apparatus of this invention (only a partial view relating to image formation on the label surface). In CD-R/RW driver 84, the optical disk 50 of this invention (CD-R disk 10 of Figure 1 ~ Figure 5, CD-RW disk 28 of Figure 6, etc.), is loaded upside down with respect to the top and back surface onto the turntable 86 (so that the label surface 52 is facing downward). When image formation is not conducted, the spindle motor 88 is not operated. Below the optical disk 50 is arranged an optical pickup 90 performing recording of data and playback of data. An optical pickup 90 is supported by a feed screw 92, so that it can move freely in the radial direction of the optical disk 50. A feed motor 94 is operated via a motor drive 96 according to instructions obtained from a system control circuit 62, so that the optical pickup 90 is moved in the radial direction of the optical disk by the rotations performed with the feed screw 93. The radial position of the optical disk on the optical pickup 90 is detected with a feed position detector 98, such as a linear cable or the like.

(0020)

The mechanism for feed in the disk radial direction, having a feed screw 92 and a feed motor 94, is supported with a feed screw 101, arranged parallel to the surface of the disk and orthogonally to the feed screw 92, enabling free movement of the entire unit in the linear direction of the tracks (in a direction orthogonal to the feed direction of the disk radial direction). A driving motor 103 provides driving operations via a motor driver 107 according to the instruction of a system control circuit 105, causing the optical pickup 90 to move in the track linear direction per each rotation of the feed screw 101. The track linear position of the optical pickup 90 is detected by a feed position detector 109 such as a linear scale or the like.

(0021)

Figure 17 shows an example of the arrangement of the feed mechanism (without showing the feed motor and the feed screw). In the mechanical base of the CD-R/RW driver is arranged a slider bar 111 in a fixed position, parallel to the face of the optical disk 50. In an optical pickup unit 113 is mounted in a fixed position a slider bar 115, orthogonally to the slider bar 11, parallel to the face of the optical disk 50. The optical pickup 90 is supported by the slider bar 115 to provide a sliding capability of the optical pickup unit 113. The optical pickup unit 111 can thus be moved along the slider bar 111 by the motor 103 and the feed screw 101 (Figure 16). In the optical pickup unit 113 is mounted in a fixed position a slider bar 115, orthogonally to the slider bar 111, parallel to the face of the optical disk 50. The optical pickup 90 is supported in the slider bar 115 to enable its sliding capability. The optical pickup 90 can thus be moved with the feed motor 94 and the feed screw 92 (Figure 16) along the slider bar 115. During image formation, the feed mechanism can be driven in both directions. During recording of data and playback of data, only the feed mechanism in the track radial direction will be driven, and the feed mechanism for the track radial direction will be stopped in its intermediate position (position in which the objective lens 90a of the optical pickup 90 is moved in the disk radial direction by the operation of the feed mechanism in the track radial direction).

[page 9]

(0022)

In addition, the feed mechanism for the track radial direction can be provided instead also with a spindle motor 88 for moving the optical pickup 90. In this case, instead of the feed motor 103 and the feed screw 101 for moving the optical pickup 90 in the track linear direction as shown in Figure 16, the spindle motor 88 is provided with a feed motor 119 and a feed screw 117 for movement in the same direction. Figure 18 shows an arrangement example of the feed mechanism in such a case (without showing the feed motor and the feed screw). In the mechanical base of the CD-R/RW driver 84, a slide bar 121 is mounted in a fixed position parallel to the face of the optical disk 50. In the slider bar 121, the spindle motor 88 is supported so as to provide a sliding capability. The spindle motor 88 is thus moved along the slider bar 121 with a feed motor 119 and a feed screw 117 (Figure 16). In the mechanical base of the CD-R/RW driver 84 is mounted in a fixed manner a slider bar 123. The slider bar 123 supports the optical pickup 90 to enable a sliding capability. The optical pickup 90 can thus be moved along the

slider bar 123 with the feed motor 94 and the feed screw 94 (Figure 16). During image formation, the feed mechanism can be driven in both directions. During data recording or playback, the feed mechanism is driven only in the track radial direction, and the feed mechanism for the track radial direction is stopped in the intermediate position (position in which the objective lens 90a of the optical pickup 90 is moved in the disk radial direction by the operation of the feed mechanism in the track radial direction).

(0023)

As shown in Figure 16, a focus servo circuit 125 drives a focus actuator of the optical pickup 90 based on the focus error signal with the instructions of the system control circuit 105, enabling to perform focusing control. When image formation is performed on the label surface, the focus servo circuit 125 is set ON. During recording and playback of data, tracking servo circuit 127 operates the tracking actuator of the optical pickup 90 based on the tracking error signal according to the instructions of the system control circuit 105, so that tracking control is performed. When image formation is performed on the label surface, the tracking servo circuit 127 is set OFF. When image formation is performed on the label surface, an oscillation signal generation circuit 129 generates a specified oscillation signal according to the instructions of the system control circuit 105 and the signal is furnished to the tracking actuator. Because of that, the objective lens of the optical pickup 90 is oscillated and an image is obtained without a gap with an embedded scan interval for the laser rays per each lap.

(0024)

Laser driver 131 drives the laser diode of the optical pickup 90 according to the instructions of the system control circuit 105, and the optical disk 50 is irradiated with laser rays, enabling data recording, data playback and image formation on the label surface.

Specifically, when the laser diode is driven with the laser driver 131, laser light is emitted with a recording power modulated with the recording signal during data recording, laser light is emitted with a constant power for data playback during data playback, and during image formation on the label surface, laser light is emitted modulated with image data such as pictures (laser rays creating a lower power when changes are not initiated in the visible optical characteristics in the part where an image is not formed, and with a high power of laser rays generating changes in the visible optical characteristics in the visible variable optical characteristics layer in the part where an image is formed). When image formation is performed on the label surface so as to create letters, pictures and similar image data, which is edited by a user from a host computer 133, this image data is sent to a CD-R/RW driver 84. The structure of this image data comprises for example dot matrix data expressing coordinates (r, t) combining the radial direction position r of the optical disk, (the distance from a suitable reference position in the disk radial direction, such as center of rotations), with the track linear direction position t, (the distance from a suitable reference position of the track linear direction), (for example, for each radial position r of a specified pitch Δr, data is stipulated in an image formation segment in the track linear direction expressed by t).

During the stage when an image is formed on the label surface of an optical disk 50 with the CD-R/RW driver 84 of Figure 16, for example the following operation can be performed.

(0025) (

(1) The optical disk is affixed to the turntable 86 upside down, reversed with respect to when data recording and playback is performed.

(2) A user edits images such as letters, pictures and the like to form an image on the display of a host computer 133.

(3) The user issues an instruction to start image formation operations with the host computer 133.

(4) The spindle motor 88 stops image formation operations according to the instructions from the system control circuit 105.

(5) A specified reference position is determined for the optical pickup 90.

(6) The laser power of the laser diode of the optical pickup 90 is specified to create a low output with the instructions of the system control circuit 105 (with a value enabling focusing control without causing changes in the visible optical characteristics of the visible variable optical characteristics layer, for instance below 1 mW), and the laser driver 131 drives the laser diode.

(7) The focus servo circuit 125 is set ON by an instruction from the system control circuit 105. Because of that, the focus servo circuit 125 will apply focus servo operations so as to create the minimum spot of the laser rays in the reflection layer. In addition, the tracking servo circuit 127 remains as is in the OFF status, so that tracking servo operations are not applied.

(8) Image formation is started by an instruction from the system control circuit, after image formation adjustments described above. Specifically, the system control circuit 105 inputs an image of the host computer 133, the feed motor 94 is driven and the position of the optical pickup 90 is determined for disk radial position, which is the location for initial image formation on the internal peripheral side of the optical disk 50.

[page 10]

In this disk radial position, the motor 103 (or 119) is driven so that laser rays are moved in the track linear position and in the disk radial position, laser power is switched to a specified high output per image formation segment in the track linear direction indicated by the image data, (with a value changing the visible optical characteristics of the visible variable optical

characteristics layer, for instance a value above 1 mW). Because of that, the visible characteristics of the visible variable optical characteristics layer will be changed in the locations irradiated with the high power laser light (color changes, etc.), and image formation will thus be performed. Thereafter, the feed motor 94 is driven, the optical pickup 90 is moved in the outer perimeter direction with a specific pitch corresponding to Δr, and while being moved in the track radial direction to this position, the operations are switched to a specified high output of the laser power applied to the image formation segment in the track radial direction as instructed by the image data, and image formation is performed in this track radial position. After that, these operations are repeated, and image formation is conducted sequentially in the external peripheral direction with a specified pitch Δr. Figure 19 shows the trajectory of laser rays on a label surface 52 of an optical disk 50, wherein an image is created with these image formation operations. Because the laser rays are moving during the oscillations caused by the oscillation signal, an image that has no gap (or a small gap) can thus be obtained.

(0026)

Also, although the visible variable optical characteristics layer was arranged between the reflection layer and the protective layer in the embodiment mode above, this does not limit the optical disk of this invention as the visible variable optical characteristics layer can be deployed in any location in which it is visible from the label surface of the optical disk (for example on top of the protective layer). Further, although the visible variable optical characteristics layer was created with an integrated construction in the embodiment mode above to explain how an image is formed on an optical disk of this invention, the image formation method on a label surface of this invention or the optical disk apparatus of this invention is not limited by this image formation. Specifically, in an optical disk wherein the construction of a visible variable optical characteristics layer is created and a label is pasted on the label surface of the optical disk, the label surface image formation or the optical disk apparatus of this invention can be also applied to achieve image formation. Furthermore, although image formation was performed on the label surface while focus servo operations were applied in the above explained embodiment, image formation can be also conducted without applying the focus servo operation if resolution of the image is not required. Since it is not necessary to obtain the reflected light necessary for focus servo in this case, the visible variable optical characteristics layer can be formed in an opaque mode so that light passing through the reflection layer cannot be seen. Also, although the power of the laser light was modulated in response to image data to form an image in said embodiment mode, it is also possible to change the visible optical characteristics of the visible variable optical characteristics layer by applying modulation to image data with another parameter of laser light than power. Further, the modified mode of the visible optical characteristics of the visible variable optical characteristics layer is not limited only to the description above, as long as visually recognizable changes are achieved.

Furthermore, although a sequential image formation was performed on the outer peripheral side from the inner peripheral side of the disk in said embodiment mode, the invention is not limited by this as image formation can be also conducted according to another suitable sequence. And while image formation was explained in said embodiments in the case of a CD-R

disk and CD-RW disk, this invention is applicable also to cases when image formation is performed on another type of optical disk. Also, although said embodiment modes explained a case when the invention was applied to an optical disk apparatus by using a connection to a host computer, this invention is not limited by this as it compatible with an optical disk apparatus which is used with a CD recorder or the like in a single unit.

(Brief Explanation of Figures)

(Figure 1)

A diagram showing a partial profile view of an embodiment mode of an optical disk of this invention.

(Figure 2)

A diagram showing a partial profile view of a modified example of the optical disk of Figure 1.

(Figure 3)

A diagram showing a partial profile view of a modified example of the optical disk of Figure 1.

(Figure 4)
A diagram showing a partial profile view of a modified example of the optical disk of Figure 1.

(Figure 5)

A diagram showing a partial profile view of a modified example of the optical disk of Figure 1.

(Figure 6)

A diagram showing a partial profile view of another embodiment mode of the optical disk of this invention.

(Figure 7)

A diagram showing a partial profile view of another embodiment mode of the optical disk of this invention.

(Figure 8)

A diagram showing a partial profile view of another embodiment mode of the optical disk of this invention.

(Figure 9)

A system configuration block diagram showing an embodiment mode of the optical disk apparatus of this invention.

(Figure 10)

A top view diagram indicating the trajectory of laser rays on the label surface with image formation operations on a label surface using the CD-R/RW driver of Figure 9.

(Figure 11)

A chart indicating the changes of laser power when image formation is conducted according to Figure 10.

(Figure 12)

A top view diagram indicating the trajectory of laser rays on a label surface when image formation is conducted without inducing oscillations of laser light in the radial direction of the disk.

(Figure 13)

A top view diagram indicating the trajectory of laser rays on a label surface when image formation is conducted while oscillation of laser light is induced in the radial direction of the disk.

(Figure 14)

A top view diagram showing an example of image formation on the label surface with the CD-R/RW driver of Figure 9.

(Figure 15)

A top view diagram showing another example of image formation on the label surface with the CD-R/RW driver of Figure 9.

(Figure 16)

A system configuration block diagram showing another embodiment mode of the optical disk apparatus of this invention.

(Figure 17)

A top view and a front view diagram explaining an arrangement example of the feed mechanism of the CD-R/RW driver of Figure 16.

[page 11]

(Figure 18)

A top view and a front view diagram explaining an arrangement example of the feed mechanism of the CD-R/RW driver of Figure 16.

(Figure 19)

A top view diagram showing an example of image formation on the label surface with the CD-R/RW driver of Figure 16.

(Explanation of Symbols)

10, 28, 41, 50 ... optical disks, 12, 30, 403, 55 ... substrates, 14, 34, 47 ... recording layers, 16, 38, 51 ... reflection layers, 18, 40, 61 ... visible variable optical characteristics layer, 20, 42 ... protective layers, 22, 44, 52 ... label surfaces, 24, 39, 59 ... intermediate layers, 26 ... hole, 35 ... separation layer, 37, 57 ... second reflection layers, 48, 84 ... CD-R/RW drivers (optical disk apparatus), 54, 86 ... turntables, 56 ... spindle motor (rotational drive apparatus), 58 ... frequency generator (peripheral direction detection apparatus), 60 ... multiplier, 62, 105 ... system control circuit (control circuit), 66, 90 ... optical pickups, 67, 91 ... laser rays, 68, 72, 92, 94, 101, 103, 111, 11, 115, 117, 119, 121, 123 ... relative movement mechanisms, 72, 94 ... feed motors (radial direction feed driving mechanism), 74, 98 ... feed position detectors (radial direction position detection mechanism), 76, 125 ... focus servo circuits, 78, 127 ... tracking service circuits, 80, 129 ... oscillation signal generation circuits, 82, 131 ... laser driver (laser modulation circuits), 103, 119 ... feed motors (track linear direction feed driving mechanism), 109 ... feed position detector (track linear direction position detection apparatus).

(Figure 1)

22: label surface
10: optical disk (CD-R)
20: protective layer
18: visible variable optical characteristics layer
16: reflection layer
14: coloring matter layer (recording layer)
12: substrate
I: incident light surface for data recording with laser rays

(Figure 2)

↑ incident light surface for data recording with laser rays

(Figure 3)

24: intermediate layer
↑ incident light surface for data recording with laser rays

(Figure 4)

(Figure 5)

(Figure 12)

52: label surface
(1) trajectory of laser rays
(2) printing locations
(3) gap
(4) radial direction
(5) peripheral direction

[page 12]

(Figure 6)

44: label surface
28: optical disk (CD-RW)
42: protective layer
40: visible variable optical characteristics layers
38: reflection layer
36: dielectric layer
34: recording layer
32: dielectric layer
30: substrate
↑ incident light surface for data recording with laser rays

(Figure 7)

44: label surface
28: optical disk (CD-RW)
42: protective layer
40: visible variable optical characteristics layer
39: intermediate layer
37: second reflection layer
35: separation layer
38: reflection layer
36: dielectric layer
34: recording layer
32: dielectric layer
30: substrate
↑ incident light surface for data recording with laser rays

(Figure 8)

65: label surface
41: optical disk (DVD-RW)
63: protective layer
61: visible variable optical characteristics layer
59: intermediate layer
57: second reflection layer
55: second substrate
53: pasting adhesive layer
51: reflection layer
49: dielectric layer
47: recording layer
45: dielectric layer
43: first substrate
↑ incident light surface for data recording with laser rays

(Figure 10)

(1) radial direction reference position
(2) trajectory of laser rays
(3) segment in which printing is conducted with a high output of laser power
(4) label surface (52)
(5) trace [sic] direction
(6) disk center

(Figure 9)

50: optical disk
67: laser rays
52: label surface
56: spindle motor
58: frequency generator (FG)
(12) FG pulse
64: spindle servo
(15) focus error
76: focus servo
68: feed screw
66: optical pickup
76: focus servo
72: feed motor
(13) tracking error
78: tracking servo
60: multiplier
74: feed position detection
(16) r information
70: motor driver
82: laser driver
80: oscillation signal generation
(14) θ information
48: CD-R/RW driver
62: system control circuit
(17) image data (r, θ)
48: host computer

(Figure 13)

52: label surface
(7) radial direction
(8) peripheral direction
(9) trajectory of laser rays
(10) : printing location
(11) : location in which printing is not conducted

[page 13]

(Figure 11)

(1) radius r1

(2) radius r1 + Δr
(3) radius r + 2 Δ
(4) reference position
(5) 1 item
(6) "H": laser power high
"L": laser power low
(7) peripheral direction position

(Figure 15) (a), (b), (c)

(Figure 14)

(a)

(b)

52: laser surface
50: optical disk
(8) trajectory of laser rays with a high output

(Figure 16)

52: laser label
88: spindle motor
117: relative movement mechanism,
119: feed motor
50: optical disk
91: laser light
90: optical pickup
(9) focus error
125: focus servo
92: feed screw
94: feed motor
(11) tracking error
127: tracking servo
98: feed position detection
96: motor driver
131: laser driver
129: oscillation signal generation circuit
107: motor driver
109: feed position detection

84: CD-R/RW driver
125: system control
(10) image data (r, t)
133: host computer

(Figure 17)

(top view)

(front view)

[page 14]

(Figure 18)

(top view)
(front view)

(Figure 19)

(1) trajectory of laser rays with a high output
(2) track linear direction
(3) disk radial direction
(4) (operations during printing)
50: optical disk
52: label surface

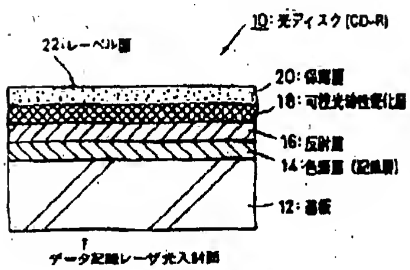
Continuation from the front page:

F Terms (Reference)

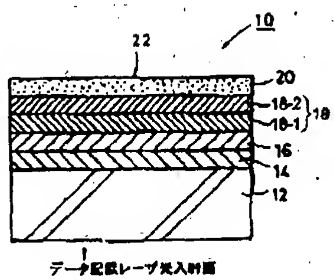
50029 JB13 PA01 RA01
5090 AA01 CC01 GG32 HH07 KK03
50117 AA02 CC04 EE00
50121 A03 EE30 GG02

【図18】 図16のCD－R／RWドライブ送り機構の配置例を示す平面図および正面図である。
【図19】 図16のCD－R／RWドライブによるレーベル面の画像形成例を示す平面図である。
【符号の説明】
10，28，41，50…光ディスク、12，30，43，55…基板、14，34，47…記録層、16，38，51…反射層、18，40，61…可視光特性変化層、20，42…保護層、22，44，52…レーベル面、24，39，59…中間層、26…孔、35…分離層、37，57…第2の反射層、48，84…CD－R／RWドライブ（光ディスク装置）、54，86…ターンテーブル、56…スピンドルモータ（回転駆動装置）、58…周波数発生器（周方向位置検出装置）、60…逓倍器、62，105…システム制御回路（制御回路）、66，90…光ピックアップ、67，91…レーザ光、68，72，92，94，101，103，111，11，115，117，119，121，123…相対移動機構、72，94…送りモータ（径方向送り駆動装置）、74，98…送り位置検出器（径方向位置検出装置）、76，125…フォーカスサーボ回路、78，127…トラッキングサーボ回路、80，129…振動信号発生回路、82，131…レーザドライバ（レーザ変調回路）、103，119…送りモータ（トラック接線方向送り駆動装置）、109…送り位置検出器（トラック接線方向位置検出装置）

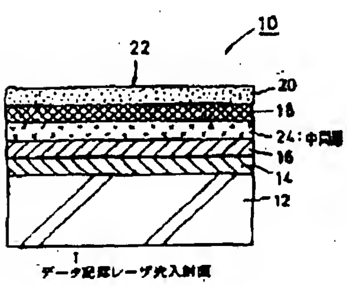
【図1】



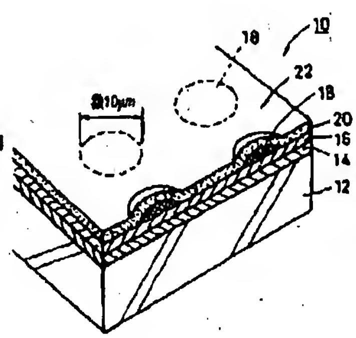
【図2】



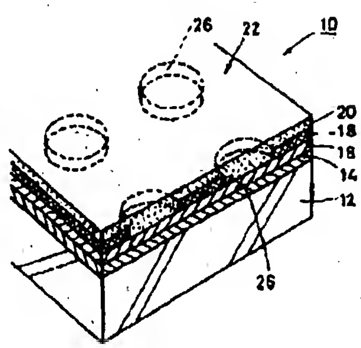
【図3】



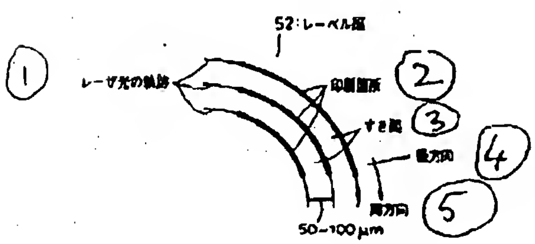
【図4】



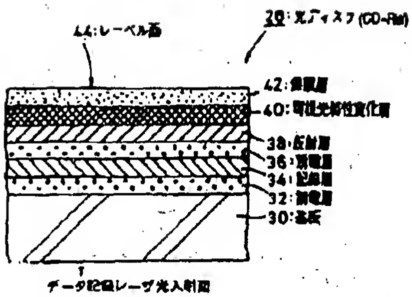
【図5】



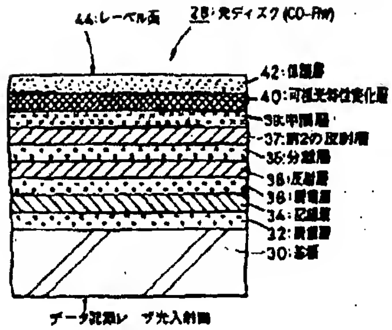
【図12】



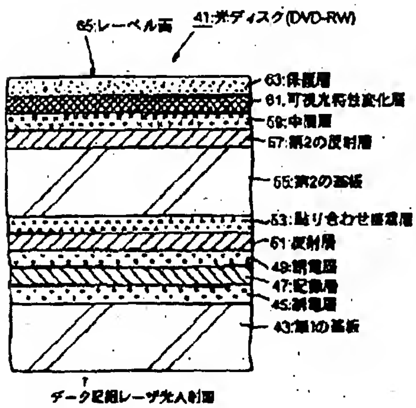
【図6】



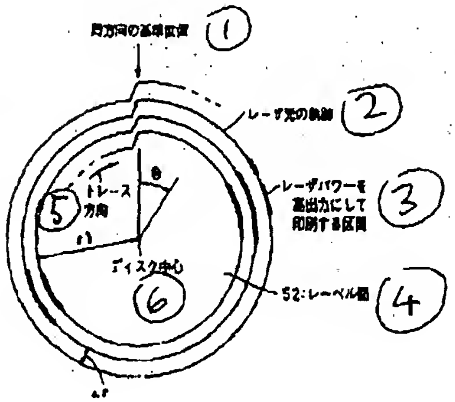
【図7】



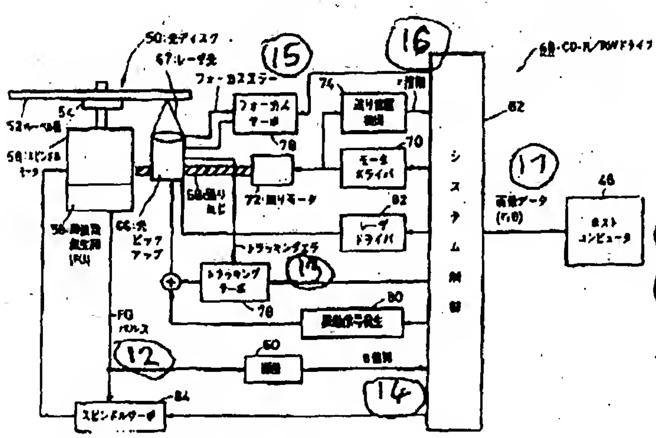
【図8】



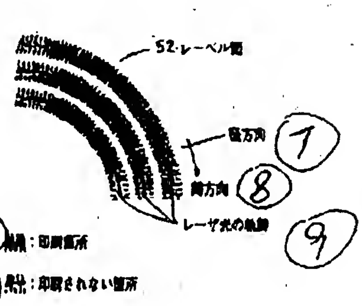
【図10】



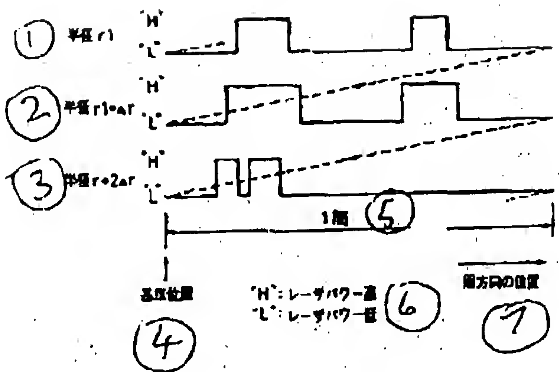
【図9】



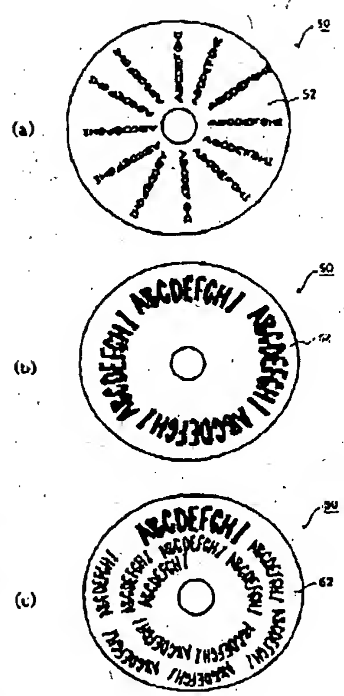
【図13】



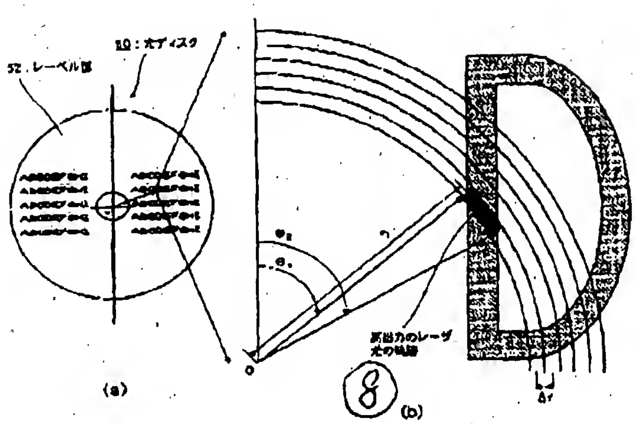
【図11】



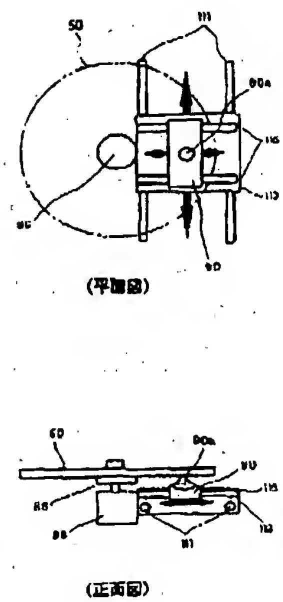
【図15】



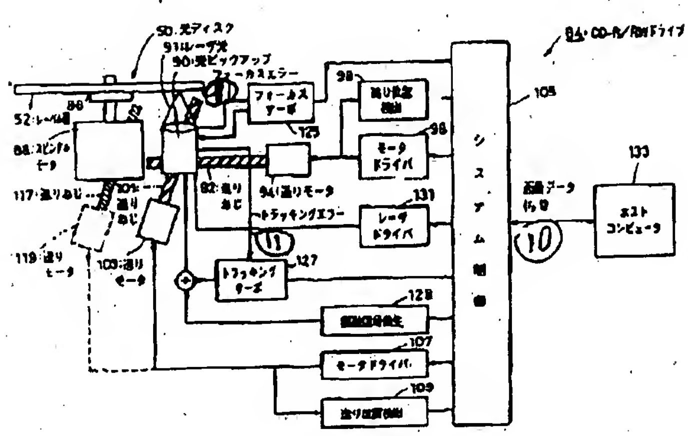
【図14】



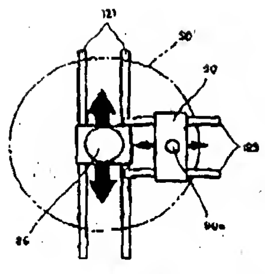
【図17】



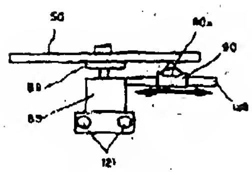
【図16】



【図18】

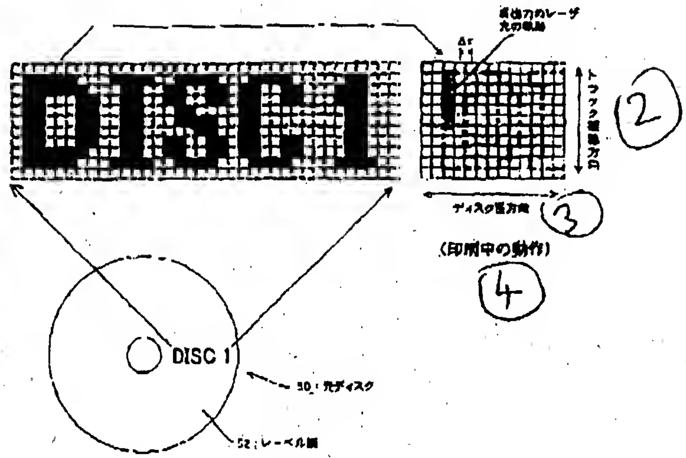


(平面図)



(正面図)

【図19】



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5D117 AA02 CC04 EE00
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